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| Course Code: CSE422 |
| Course Title: Computer Graphics Lab |
| Credits: 2 |

**Course Content**

**Output Primitives:** Points and Lines, Different shape design, Line Drawing Algorithm, DDA Algorithm, Bresenham’s Line Algorithm, Circle-Generating Algorithms, Properties of Circles, Midpoint Circel Algorithm. **Two-Dimensional Geometric Transformations:** Basic Transformations, Translation, Rotation, Scaling, Reflection, Shear. **Color Models and Color Applications**: Properties of Light, RGB Color Model. **Computer Animation:** Design of Animation Sequences

**Course Rationale**

Computer Graphics and Design - Foundation Level 2 provides applied learning opportunities for learners with an interest in computer graphics who are looking to foster a career within design-based industries and/or wish to prepare for further study in Computer Graphics and Design Level 3.

**Course Objective**

* To create interactive graphics applications
* To use C++ builds functions or equivalent graphics tools
* To perform simple 2D graphics with lines, curves and can implement algorithms to rasterizing simple shapes, fill and clip polygons and have a basic grasp of anti-aliasing techniques.

**Course Learning Outcomes (CLO’s)**

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| --- | --- |
| CLO1 | Able to **demonstrate** effective OpenGL programs to solve graphics programming issues including different shapes. |
| CLO2 | Able to **analyze** colour modelling, shading and animation. |
| CLO3 | Able to **apply** different algorithms to draw Line, Circle and different shapes. |
| CLO4 | Able to **apply** 2D and 3D transformation |

**Program Outcomes (PO’s)**

Program Outcomes are reported in Appendix-I.

**CO-PO Mapping**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| PLO’s  CLO’s | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 | PLO11 | PLO12 |
| CLO1 | 3 |  |  |  |  |  |  |  |  |  |  |  |
| CLO2 |  | 3 |  |  |  |  |  |  |  |  |  |  |
| CLO3 |  |  | 3 |  |  |  |  |  |  |  |  |  |
| CLO4 |  |  | 3 |  |  |  |  |  |  |  |  |  |

**Mapping Course Learning Outcome (CLOs) with the Teaching-Learning and Assessment Strategy:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CLO’s** | **Teaching Learning Strategy** | **Assessment Strategy** | **Corresponding**  **PLO number** | **Domain Level/Learning**  **Taxonomy** |
| CLO1 | Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture video, Lecture note, Open discussion | Lab Performance, Assignment, Viva | PLO1 | L1, L2 |
| CLO2 | Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture video, Lecture note, Open discussion | Lab Performance, Assignment, Viva | PLO2 | L4 |
| CLO3 | Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture video, Lecture note, Open discussion | Lab Performance, Viva, Assignment. Lab Final | PLO3 | L3 |
| CLO4 | Brainstorming sessions, Classroom discussion, Voice over PPT, Lecture video, Lecture note, Open discussion | Lab Performance, Viva, Assignment, Lab Final | PLO3 | L3 |

**Course Delivery Plan/Lesson Delivery Plan**

| **Week/Lesson**  **(Hour)** | **Experiment Name and Details** | **Student Activities** | **Name of the tools** | **Mapping with CLO** | **Assessment Plan** |
| --- | --- | --- | --- | --- | --- |
| Lab 1 | **Exp Name: Draw a Home**  Fundamental knowledge about OpenGl, installation and working with some basic built in functions. | Environment creation and Problem solving in the lab | Visual Studio Code, OpenGL and GLUT | CLO1, CLO2 | Lab Performance, Lab report, Viva |
| Lab 2 | **Exp Name: Draw 4 stars**  Working with different shapes by changing colors like star, home. | Problem solving in the lab | Visual Studio Code, OpenGL and GLUT | CLO1, CLO2 | Lab Performance, Lab report, Viva |
| Lab 3 | **Exp Name: Draw 8 X 8 chess board**  Working with shapes by using for loops to create a chess board | Problem solving in the lab | Visual Studio Code, OpenGL and GLUT | CLO1, CLO2 | Lab Performance, Lab report, Viva |
| Lab 4 | **Exp Name: Implementation of DDA line drawing algorithm**  -Exercise based on class discussion  -Problem solving in the lab | Problem solving in the lab | Visual Studio Code, OpenGL and GLUT | CLO1, CLO3 | Lab Performance, Lab report, Viva, Assignment |
| Lab 5 | **Exp Name: Implementation of Bresenham’s Line Drawing algorithm**  -Exercise based on class discussion  -Problem solving in the lab | Problem solving in the lab | Visual Studio Code, OpenGL and GLUT | CLO1, CLO3 | Lab Performance, Lab report, Viva, Assignment |
| Lab 6 | **Exp Name: Implementation of Mid-Point Circle Drawing algorithm**  -Exercise based on class discussion  -Problem solving in the lab | Given Problem solving in the lab | Visual Studio Code, OpenGL and GLUT | CLO1, CLO3 | Lab Performance Test, Lab report, Viva |
| Lab 7 | Project Follow up | Project work completed (%) | Visual Studio Code, OpenGL and GLUT |  | Viva |
| Lab 8 | **Exp Name: Draw a flag of Bangladesh by using Circle algorithm**  -Exercise based on class discussion  -Problem solving in the lab | Problem solving in the lab | Visual Studio Code, OpenGL and GLUT | CLO1, CLO2, CLO3 | Lab Performance, Viva, Assignment |
| Lab 9 | **Exp Name: Draw a “Shahid Minar” of Bangladesh by using Circle algorithm**  -Exercise based on class discussion  -Problem solving in the lab | Problem solving in the lab | Visual Studio Code, OpenGL and GLUT | CLO1, CLO2, CLO3 | Lab Performance, Viva, Assignment |
| Lab 10 | **Exp Name: Draw a bi-cycle**  -Exercise based on class discussion  -Problem solving in the lab | Problem solving in the lab | Visual Studio Code, OpenGL and GLUT | CLO1, CLO2 | Lab Performance, Viva, Assignment |
| Lab 11 | **Exp Name: Implementation of 2D transformation**  -Exercise based on class discussion  -Problem solving in the lab | Given Problem solving in the lab | Visual Studio Code, OpenGL and GLUT | CLO1, CLO2, CLO4 | Lab Performance Test, Viva |
| Lab 12 | Project follow-up | Project work completed (%) | Visual Studio Code, OpenGL and GLUT | None | Viva |
| Lab 13 | **Exp Name: Implementation of moving particles**  -Problem solving in the lab | Problem solving in the lab | Visual Studio Code, OpenGL and GLUT | CLO1, CLO2, CLO4 | Lab Performance, Viva, Assignment |
| Lab 14 | Project Presentation and Lab Quiz | Project Show and Lab quiz | Visual Studio Code, OpenGL and GLUT | None | Lab Performance, Viva, quiz |
| Lab 15 | Practice for lab final exam | Practice all algorithms and different shapes design | Visual Studio Code, OpenGL and GLUT | None | None |
| Lab 16 | Lab Final | Given Problem solving in the lab | Visual Studio Code, OpenGL and GLUT |  | Lab Final Test, Viva |

**Assessment Pattern:**

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| --- | --- |
| **Assessment Task** | **Mark**  **(Total=100)** |
| Attendance | 10 |
| Lab Performance | 25 |
| Assignment | 10 |
| Team Project | 25 |
| Lab Final | 30 |

**Assessment Rubric:**

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| --- | --- | --- | --- | --- | --- |
| **Assessment Task** | **100%**  **Mark** | **75%**  **Mark** | **50%**  **Mark** | **25%**  **Mark** | **0%**  **Mark** |
| Attendance  (10) | Present in 100% lab | Present in 75% lab | Present in 50% lab | Present in 25% lab | Present in 0% lab |
| Lab Performance  (25) | * 1. Daily Lab Task Solving = 25   2. Lab Performance Test -1 + Viva = 25   3. Lab Performance Test -2 + Viva= 25   **Average of i, ii and iii** | | | | |
| Assignment  (10) | Solved all problems + Clear understanding | Solved 75% problems + clear understanding | Solved 50% problems + clear understanding | Solved 25% problems + not clear understanding | Solved 0% problems + No basic understanding |
| Team Project  (25) | Completed Full project with Clear understanding | Completed 75% with Clear understanding | Completed <60% with Clear understanding | Completed <50% with not Clear understanding | No Project / Project with zero understanding |
| Lab Final  (30) | Solved all the problem + answered all the question in viva | Solved 75% problem + answered all the question in viva | Solved 50% problem + answered all the question in viva | Solved 25% problem + answered all the question in viva | Solved 0% problem / could not answer any question in viva |

**Learning Materials:**

**Textbook**

Computer Graphics, by Donald Hearn, M. Pauline Baker

**Reference Books**

1. Schaum's Outline of Computer Graphics by Ray Plastock, Gordon Kalley, Zhiang Xiang, Zhingang Xiang

2. C Programming Using Turbo C++ by Robert Lafore

3. Fundamentals of Computer Graphics, by Peter Shirley et al., ISBN 978-1568812694

4. Interactive Computer Graphics: A Top-Down Approach with Shader-Based OpenGL by Shreiner and Angel, Pearson Education ISBN 9780273752264

5. Computer Graphics: Principles and Practice by Foley, Van Dam, Feiner, & Hughes, Addison-Wesley ISBN 0201848406

**Program outcomes**

Program Outcomes (POs) are narrower statements that describe what students are expected to know and be able to do by the time of graduation. These relate to the knowledge, skills and attitudes that students acquire while progressing through the program. The program must demonstrate that by the time of graduation, students have attained a certain set of knowledge, skills and behavioral traits to some acceptable minimum level. The BAETE specifically requires that students acquire the following graduate attributes.

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| **POs** | **Category** | **Program Outcomes** |
| **PO1** | **Engineering Knowledge** | Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems. |
| **PO2** | **Problem Analysis** | Identify, formulate, research the literature and analyze complex engineering problems and reach substantiated conclusions using first principles of mathematics, the natural sciences and the engineering sciences. |
| **PO3** | **Design/Development of Solutions** | Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety as well as cultural, societal and environmental concerns. |
| **PO4** | **Investigations** | Conduct investigations of complex problems, considering design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions. |
| **PO5** | **Modern tool usage** | Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations. |
| **PO6** | **The engineer and society** | Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice. |
| **PO7** | **Environment and sustainability** | Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development. |
| **PO8** | **Ethics** | Apply ethical principles and commit to professional ethics, responsibilities and the norms of the engineering practice. |
| **PO9** | **Individual work and teamwork** | Function effectively as an individual and as a member or leader of diverse teams as well as in multidisciplinary settings. |
| **PO10** | **Communication** | Communicate effectively about complex engineering activities with the engineering community and with society at large. Be able to comprehend and write effective reports, design documentation, make effective presentations and give and receive clear instructions. |
| **PO11** | **Project management and finance** | Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work as a member or a leader of a team to manage projects in multidisciplinary environments. |
| **PO12** | **Life Long Learning** | Recognize the need for and have the preparation and ability to engage in independent, life-long learning in the broadest context of technological change. |